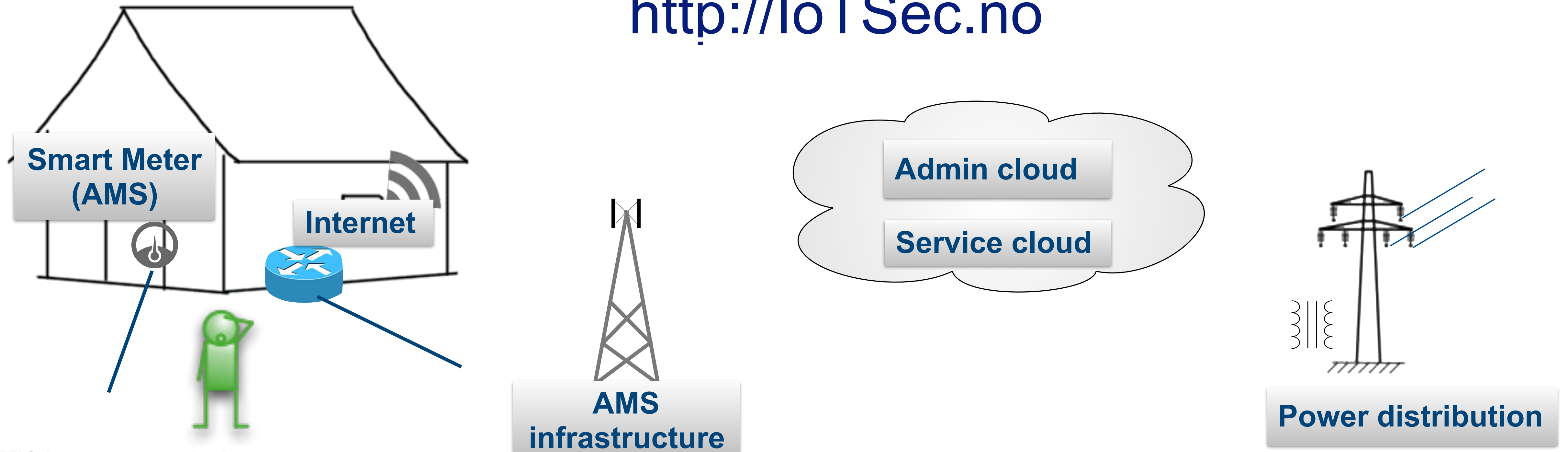


## Status and Challenges of the Smart Grid infrastructure

<http://IoTSec.no>

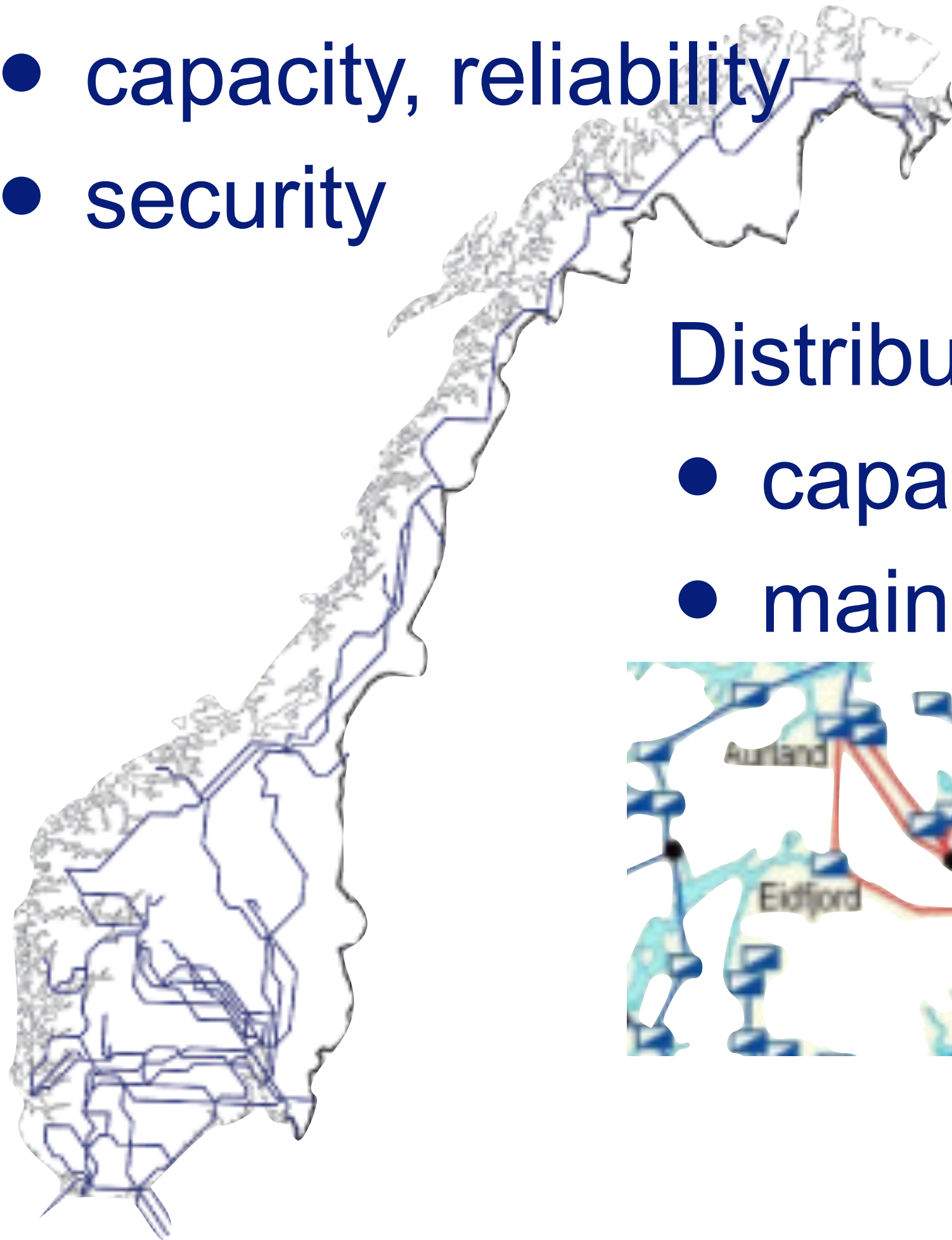


# From power lines to Smart Meter Infrastructure & Services



## Transmission Grid

- capacity, reliability
- security

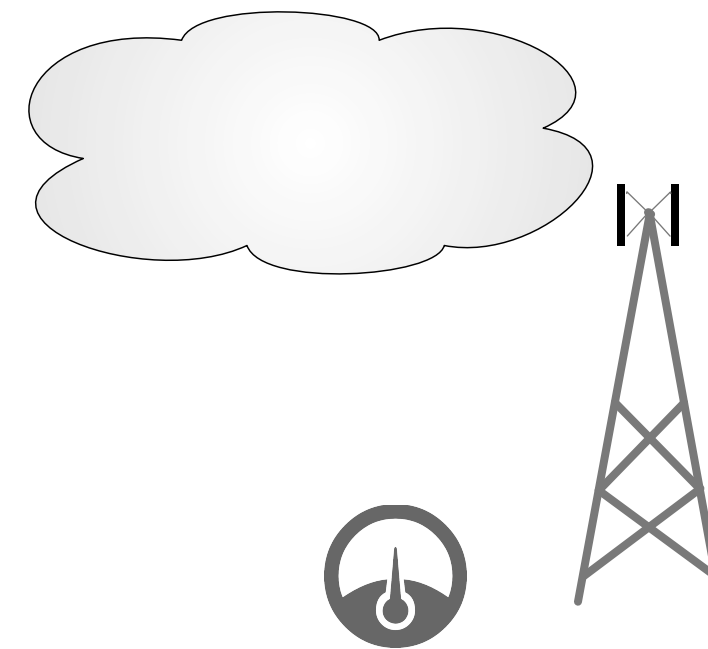
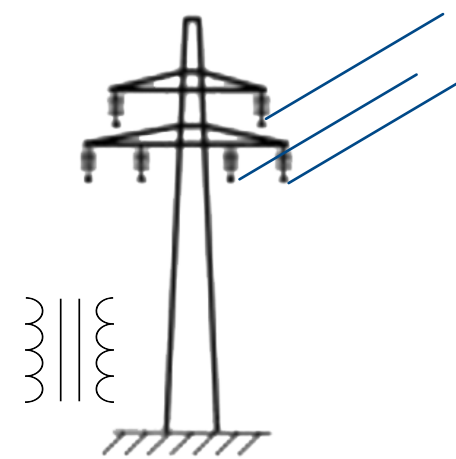
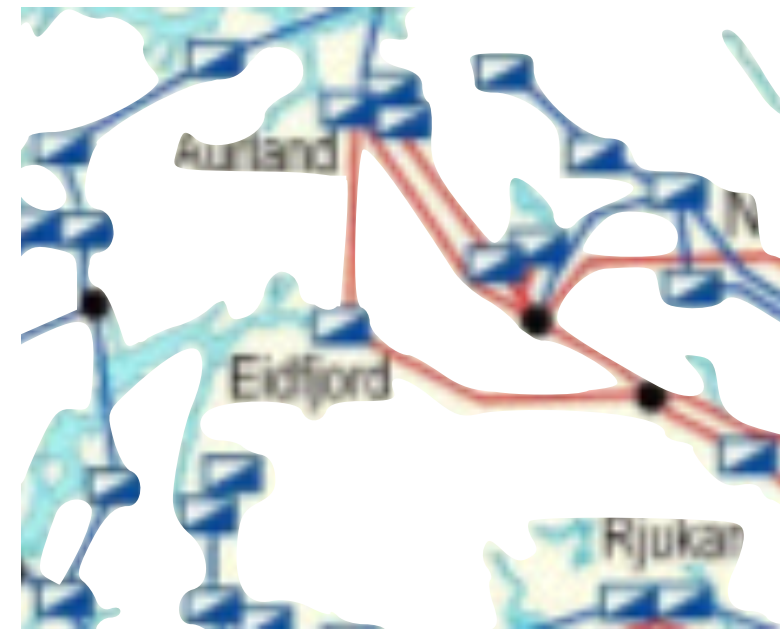


## Smart Grid Infrastructure

- smart meter
- security

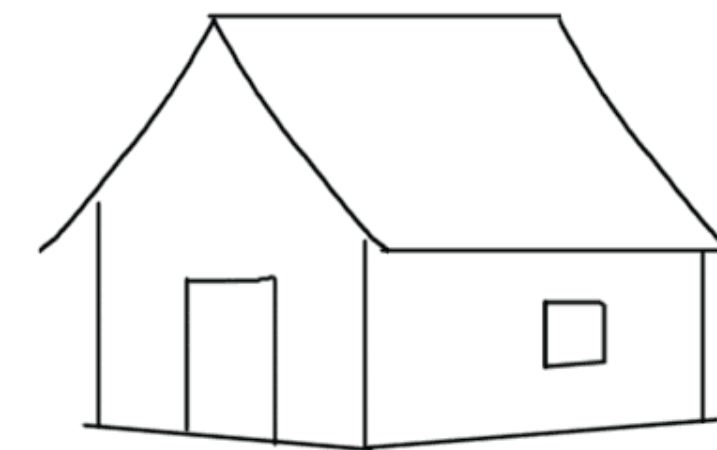
## Distribution Grid

- capacity
- maintainability



## Smart Home

- privacy, security
- societal challenges



## Future infrastructure/ services

- digitisation/Home4.0
- alarm, "green"



# Physics: Why Smart Grids become unstable

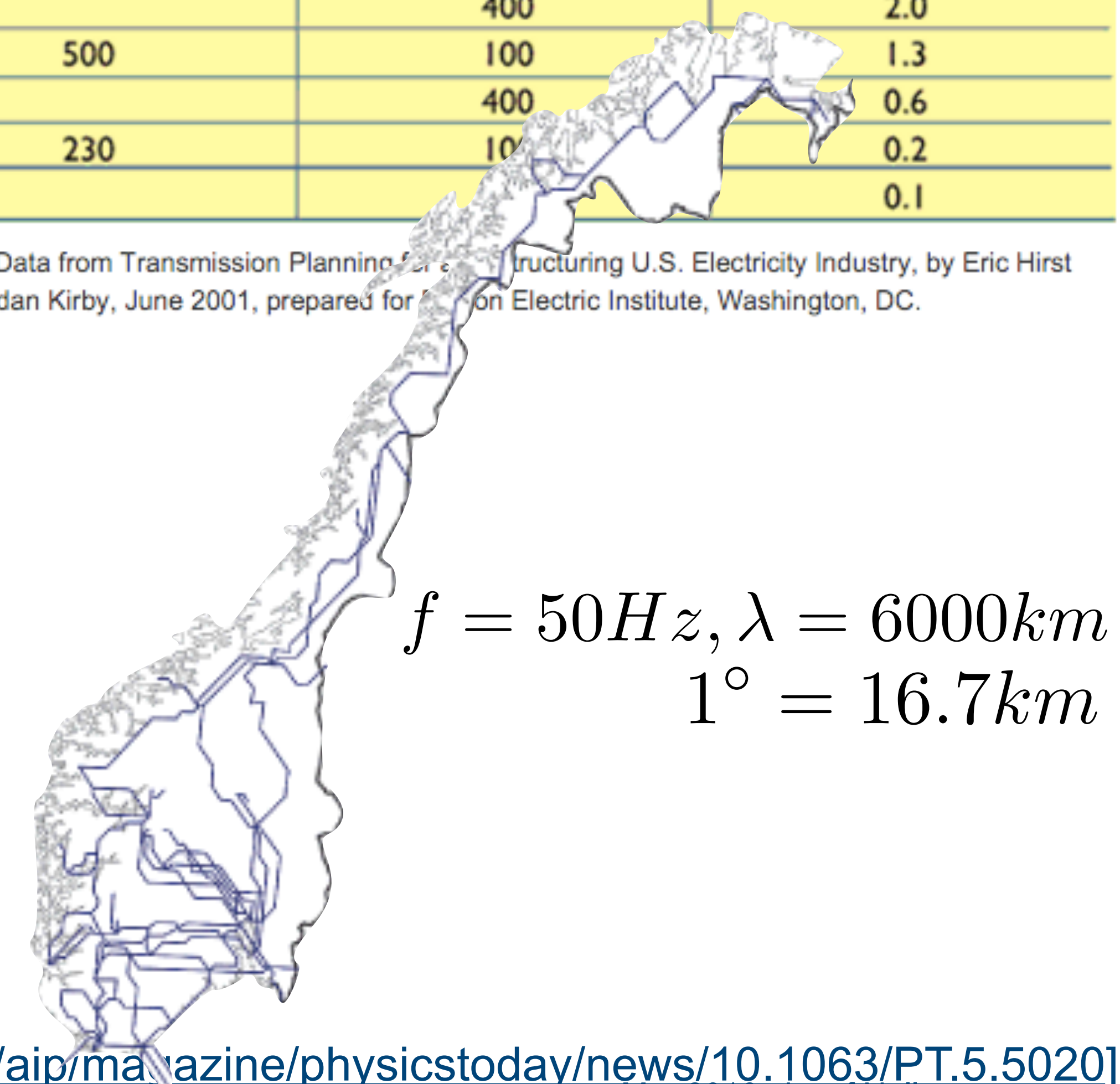


- Stable grid at 50 Hz required
  - ➔ higher consumption, lower Hz
  - ➔ (a car on auto mode uphill)
- A generator drop of 2 Hz will create heat and destroy the generator
  - ➔ 0,03 Hz drop causes 1 GW reduced power provision (=50% of capacity of 765 KV) (Eastern Interconnect USA)

**TABLE I. CAPACITY LIMITS FOR ELECTRICAL TRANSMISSION LINES**

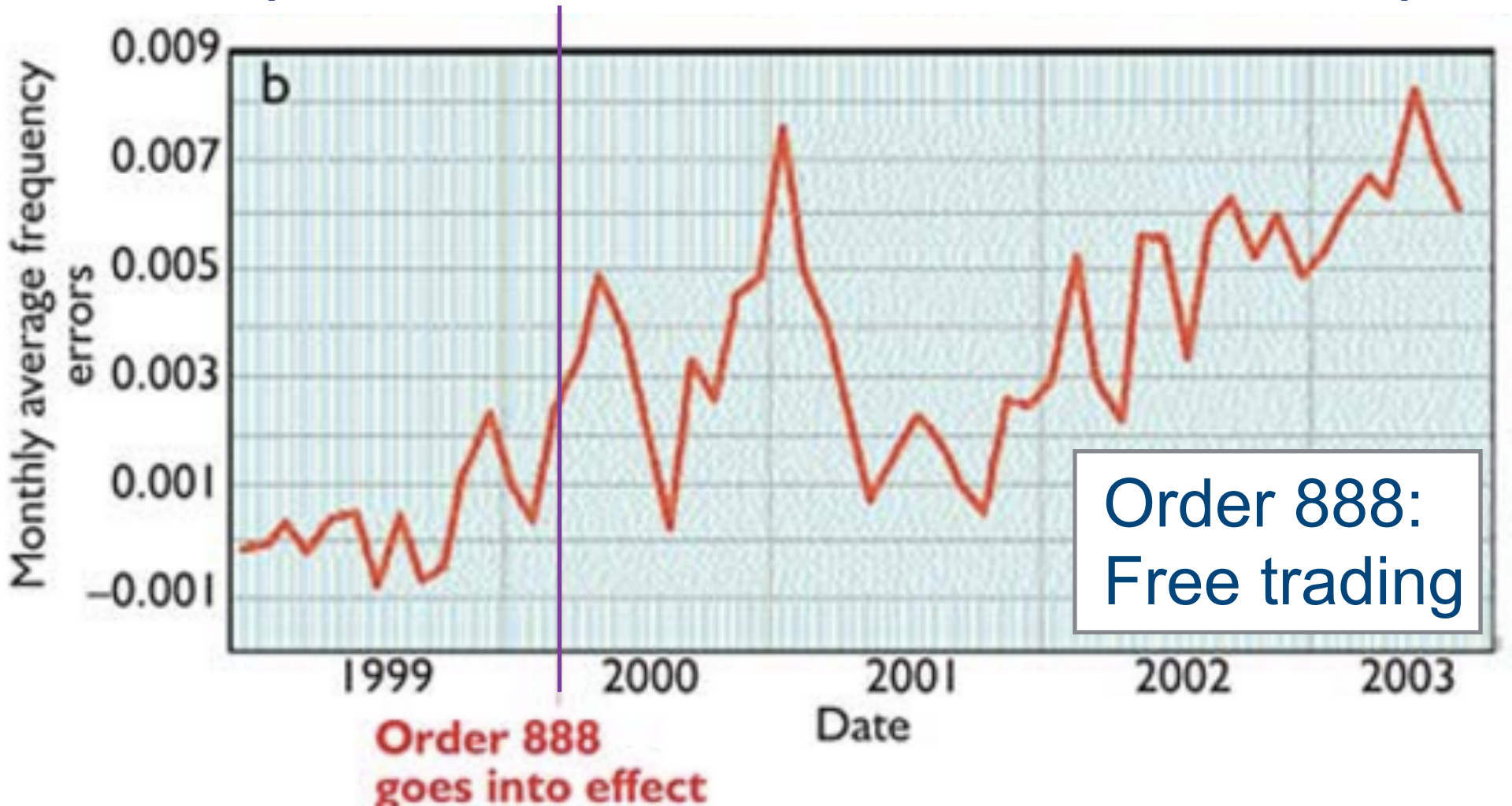
Voltage (kV)	Length (miles)	Maximum capacity (GW)
765	100	3.8
	400	2.0
500	100	1.3
	400	0.6
230	100	0.2
	400	0.1

Table 1. Data from Transmission Planning for Restructuring U.S. Electricity Industry, by Eric Hirst and Brendan Kirby, June 2001, prepared for Edison Electric Institute, Washington, DC.



$$f = 50Hz, \lambda = 6000km$$

$$1^\circ = 16.7km$$



# Impact of blackouts: Notable wide-scale power outage



- Notable wide-scale power outage
  - at least 1 Million person hours of disruption
  - worldwide: >6 events each year
  - source: [https://en.wikipedia.org/wiki/List\\_of\\_major\\_power\\_outages](https://en.wikipedia.org/wiki/List_of_major_power_outages)
- Worldwide
  - India (2012): 620 M people affected
  - India (2001): 150 M people
  - Bangladesh (2014): 120 M
- Europe & America
  - Brazil & Paraguay (2009): 87 M
  - Turkey (2015): 70 M
  - USA/Canada (NorthEast, 2003): 55 M
  - Italy, CH, AU, SL, CZ (2003): 55 M
  - ... F, DE, NL, P, BE, IT (2006): 15 M



Skyline of Toronto during the Northeast blackout of 2003

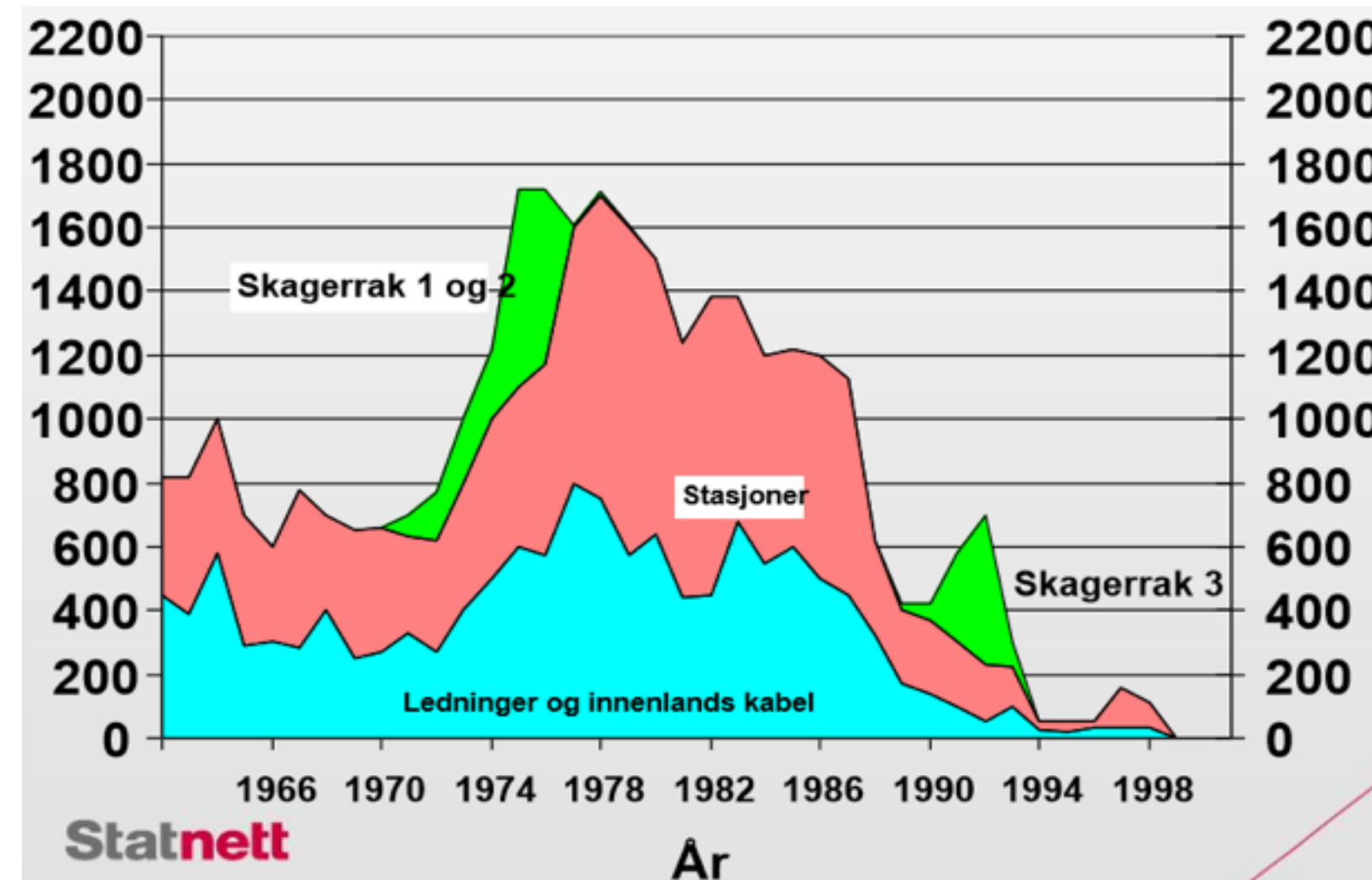
## Reasons (2014 & 2015)

- techn. fault power station (Pakistan, NL, Turkey)
- wind storm (USA), Typhoon (Philippines)
- coal silo collapse, too high demand (ZA)
- damaged cable (Malta)
- electrical fire (New Zealand)
- maintenance shift (Egypt)

# Smart Grid Motivation



- Save on investments, higher profit rate, better stability, renewables, some cost reduction in employees (vs higher knowledge demand)
- Possible new services based on acquired data (big data)
- Operational stability
  - ➔ Integration of the volatile production of renewables
  - ➔ Synchrophasor operations
  - ➔ Microgrids – possibility for island operation – internet-like operation
- Higher electricity price for households
  - ➔ Can lower the pressure on the network for consumer peak hours
  - ➔ Can enable new services to be delivered by the utility
- Relevance for Norway:
  - ➔ Easy-controllable water plants
  - ➔ Low investment since 25 years



[Source: György Kálmán, CCIS]

# Advanced Metering Systems



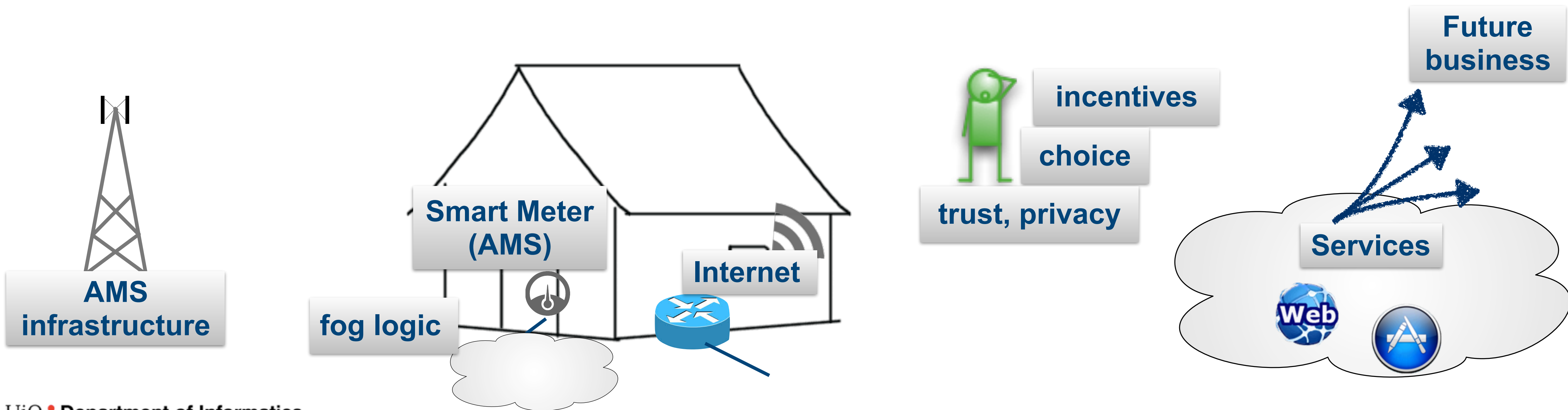
- History: smart metering was present for big consumers since more than a decade,
- Now moving to the household, required by law (in Norway)
- Adds new possibility for load control: consumer (AMS), generation, big consumers, energy storage
  - ➔ Operations central (at grid control) [load control] – operations central (at local power utility) [load control] – consumer [smart meter with remote switch-off]
- Assumes IPv6 – ref. to L3 – problems with firewalls
  
- Meter components
  - ➔ Tamper resistance is key (both for utility and consumer)
  - ➔ CPE with potentially one interface in home network (home automation) and utility (reporting)
  - ➔ Firewall? Future proofing? Ownership on traffic? Availability requirements?
  - ➔ Health-Safety-Environment



[Source: György Kálmán, CCIS]

# Research on IoT Security

<http://IoTSec.no>



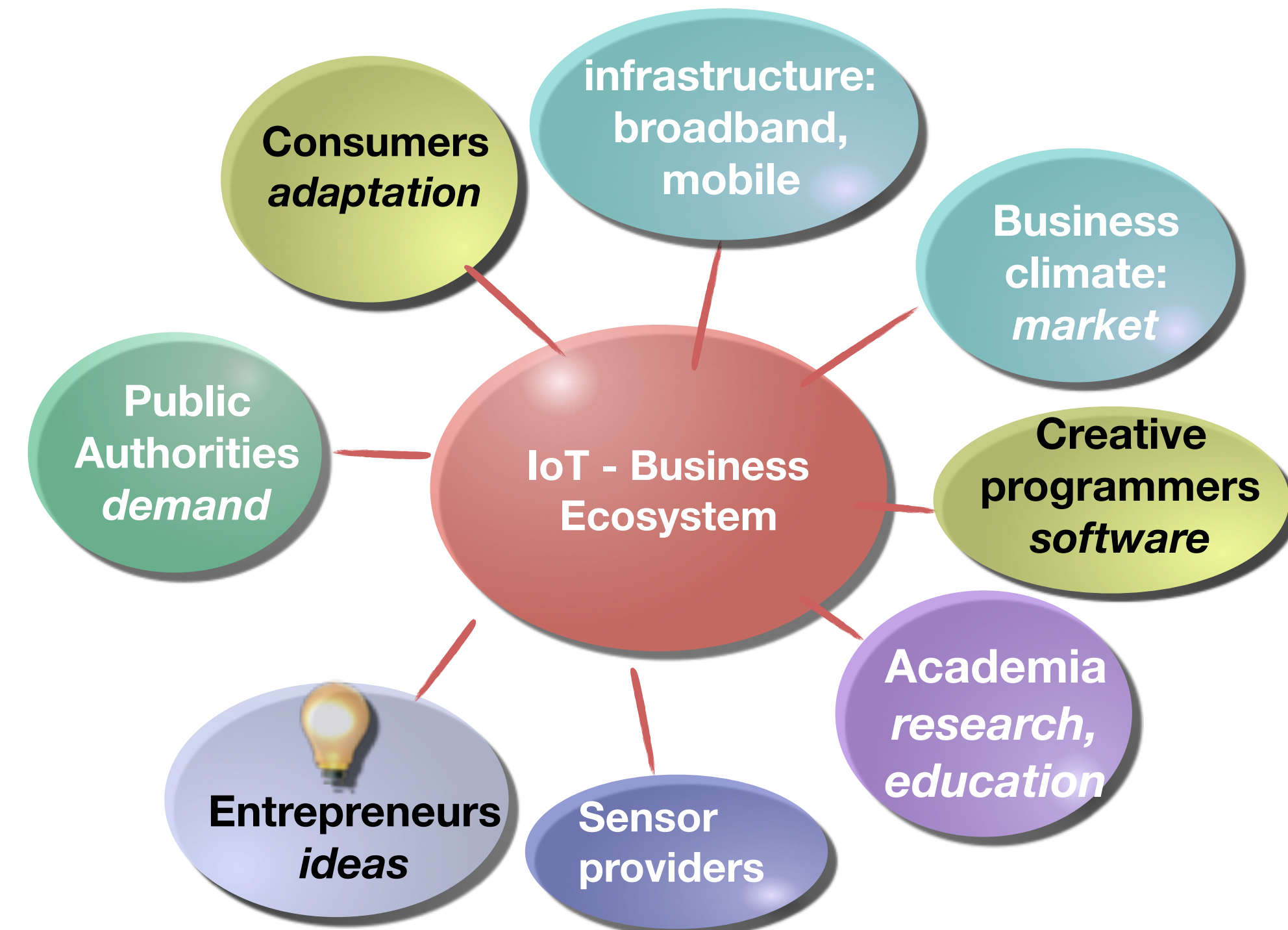
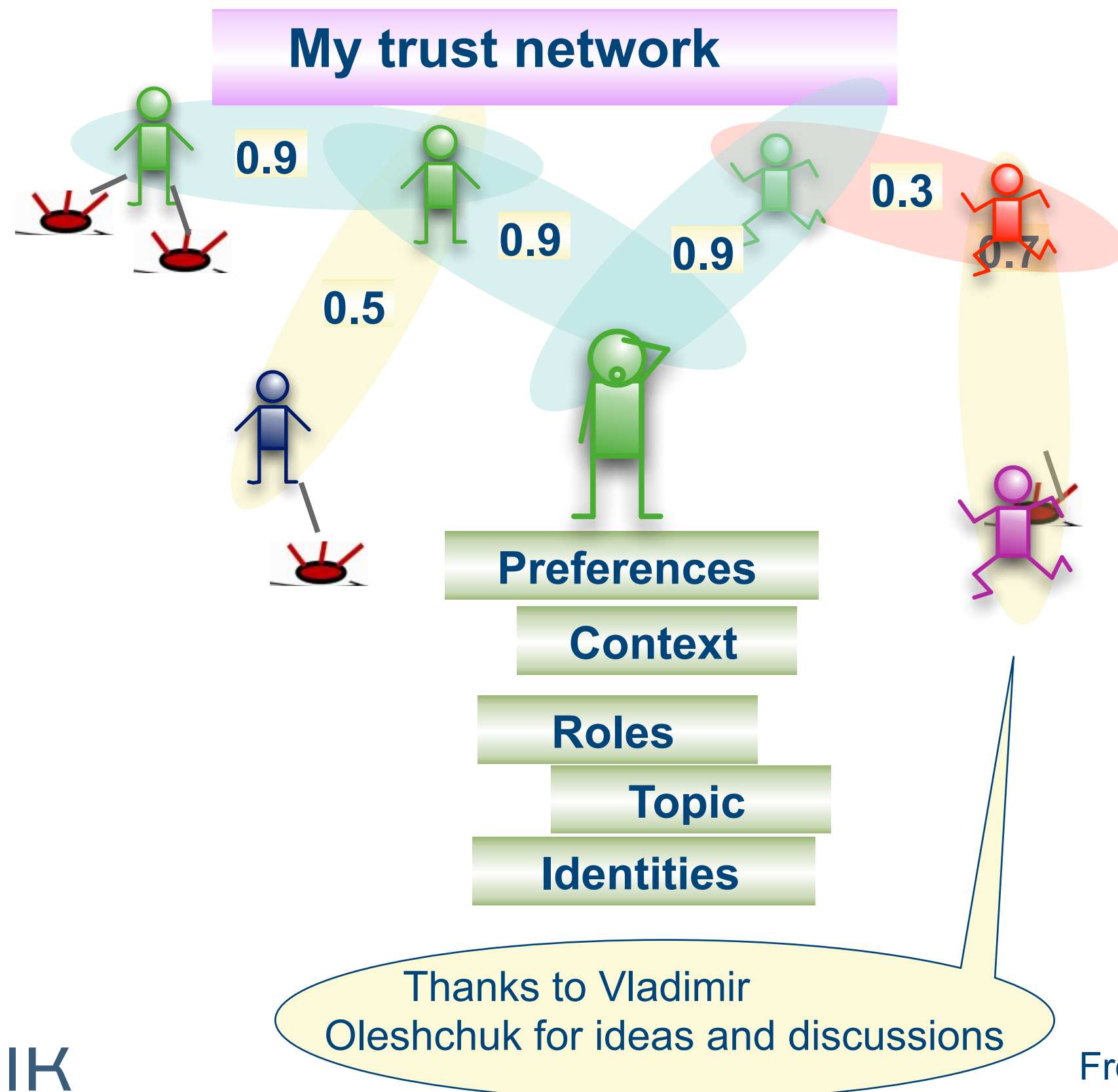
# Security and Privacy

## From Research to Innovation Ecosystem



- Discussions on trust and identities
  - ➔ 2004 what is my identity?
  - ➔ challenges: complexity, relations, reflexive trust,...

- Business ecosystem for IoT
  - ➔ successful entrepreneurship?
  - ➔ key advantages of Norway?
  - ➔ opportunities







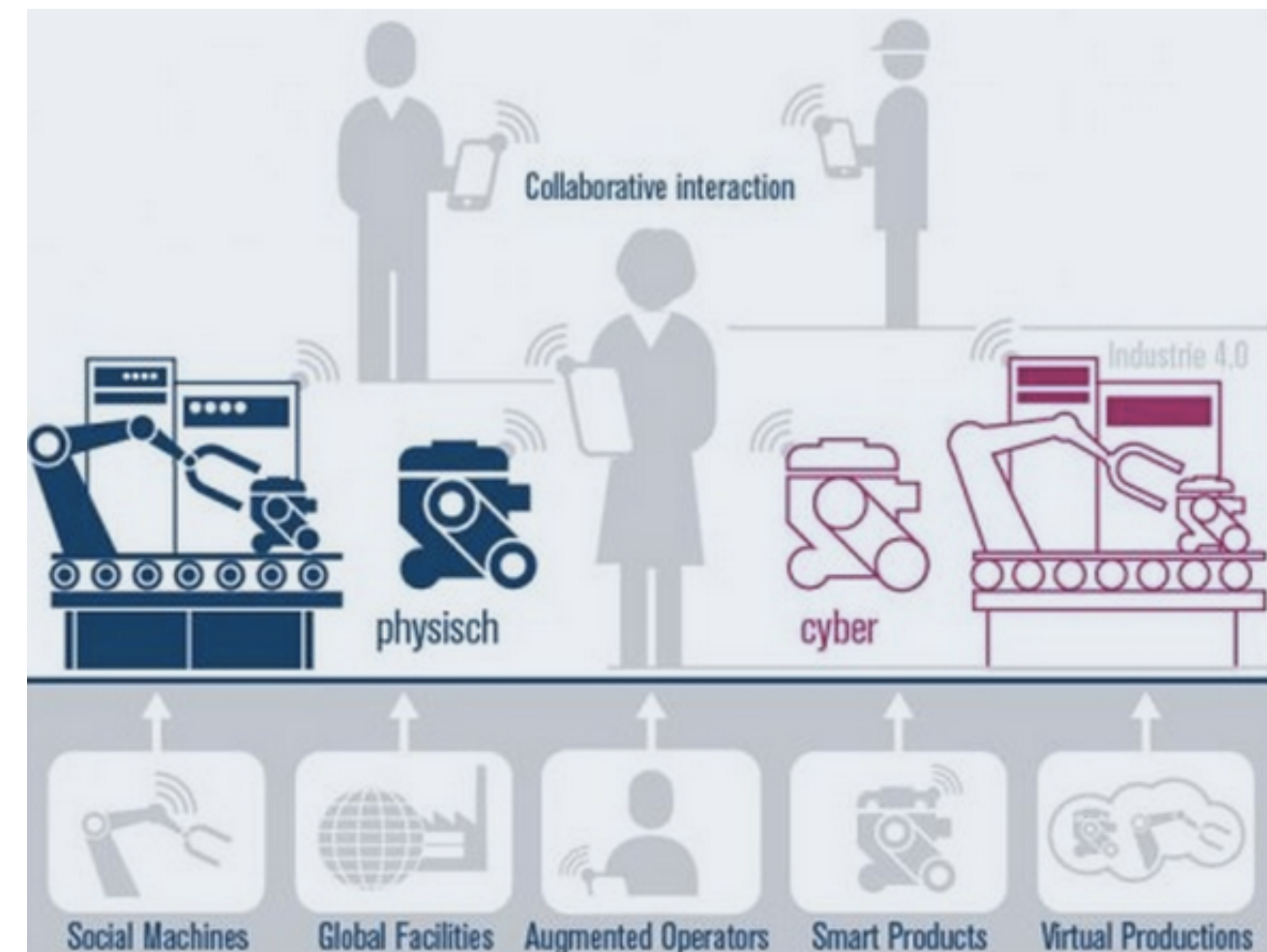
## Digital Norway

“Transform the society”



## Industrie4.0

“transforming industry/  
removing the Digital Gap”



Source: Trumpf / Forschungsunion  
Wirtschaft & Wissenschaft

# Background: Digitalisation of Industry

- EU has introduced<sup>1</sup> **Industrie4.0**
  - digital innovation hubs,
  - leadership in digital platforms,
  - closing the digital divide gap
  - providing framework conditions
- Norwegian Government has established<sup>2</sup> “Klyngene som omstillingsmotorer” (Sep2015)
  - NCE Smart Energy Markets on “**Digitalisation of Industry**”
  - NCE Systems Engineering på Kongsberg og NCE Raufoss on Productivity and Innovation
- **InDigO** is extending the Partnership into Academia

Det er i gang en massiv revolusjon innenfor IT-området – denne revolusjonen innebærer et fundamentalt skifte i teknologiplattform innenfor de fleste bransjer. **Big Data** og **Internet of Things** er ikke lenger fremtid – det er nåtid. Det blir kritisk for konkurransekraften å benytte og utvikle produkter og tjenester med utgangspunkt i denne nye virkeligheten. NCE Smart Energy Markets har bygget opp et meget sterkt og ledende miljø innenfor Big Data og Internet of Things. Det er i dag et **stort underskudd i Norge** på denne type kritisk kompetanse og NCE Smart Energy Markets vil derfor samarbeide med flere av de andre GCE, NCE og Arena klyngene i tillegg **til relevante fagmiljøer** for å spre denne kompetansen til en størst mulig del av relevant næringsliv. *(Knut Johansen, styreleder NCE Smart)*



<sup>1</sup> [http://europa.eu/rapid/press-release\\_SPEECH-15-4772\\_en.htm](http://europa.eu/rapid/press-release_SPEECH-15-4772_en.htm)

<sup>2</sup> <http://abelia.no/innovasjon/klyngene-skal-omstille-norge-article3563-135.html>

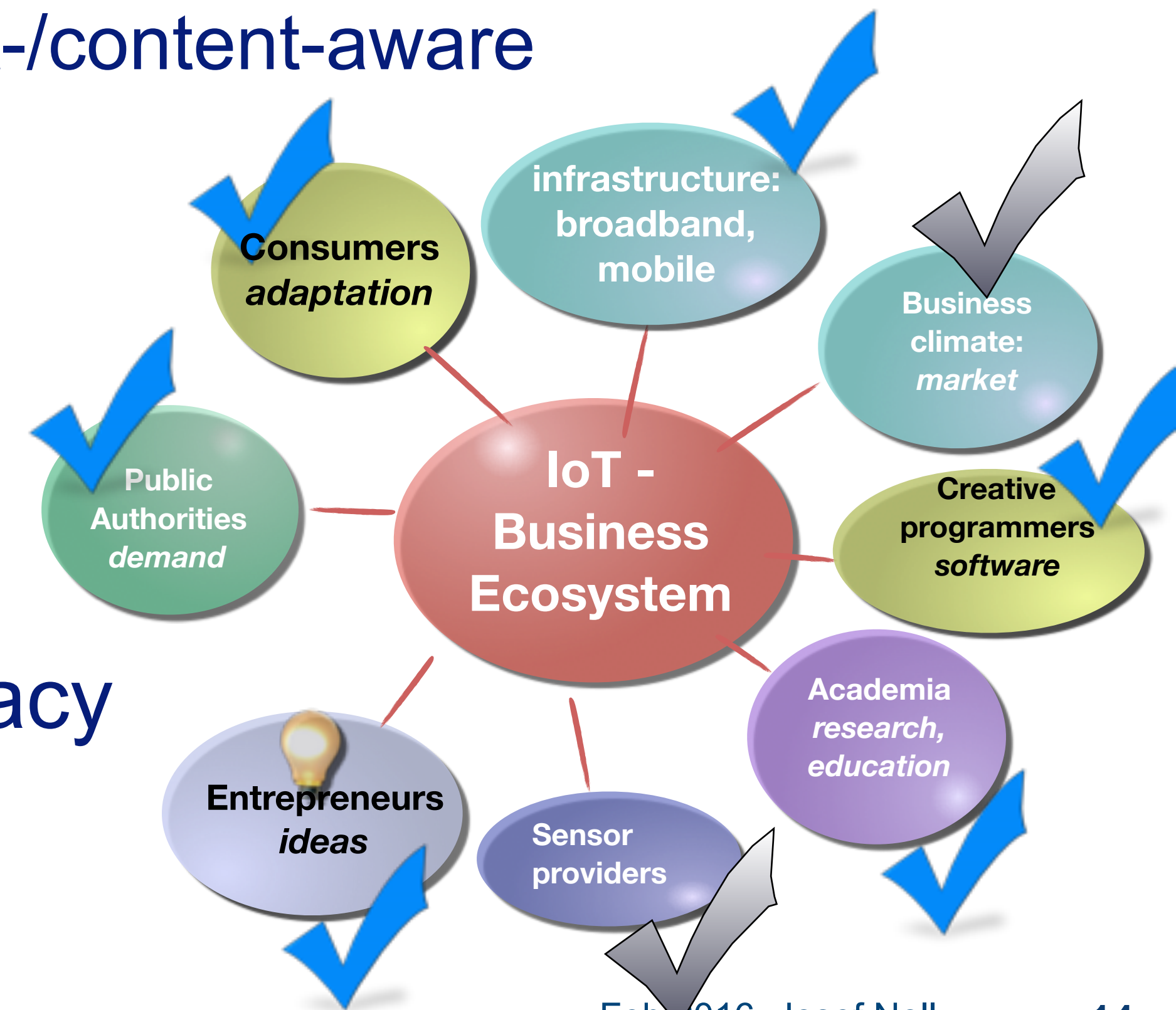
# Security and Privacy Business opportunities



- Societal challenges
  - ➔ climate, CO2
  - ➔ eHealth, “we are getting older”
- Implicit trust
  - ➔ “we talk Norwegian”
- Sensor and IoT
  - ➔ “how can sensors talk Norwegian?”



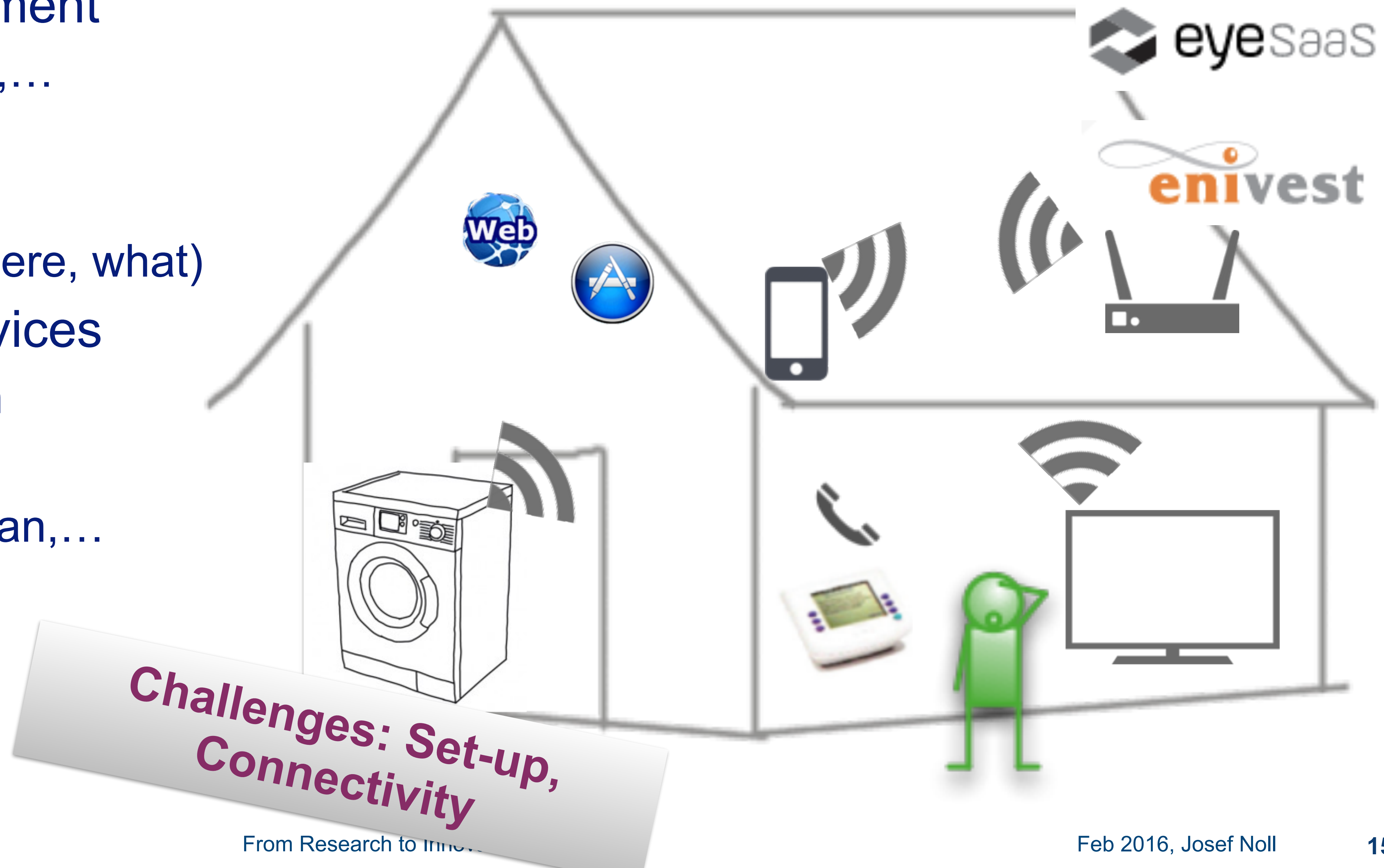
- Business opportunities in Norway
- Demand
  - ➔ mobile/wireless, autonomy
  - ➔ “me”, context-/content-aware
- Adaptation:
  - ➔ infrastructure
  - ➔ business environment
  - ➔ trust
- Security, privacy



# Home infrastructure Communications and Insight



- Distributed equipment
  - ➔ router, TV, mobile,...
  - ➔ authentication
  - ➔ traffic routing
  - ➔ service logics (where, what)
- Collaborative services
  - ➔ owner information
  - ➔ service data
  - ➔ statistics, e.g. urban,...
- Local decisions
  - ➔ knowledge cloud
  - ➔ fog computing



# Upcoming Infrastructure

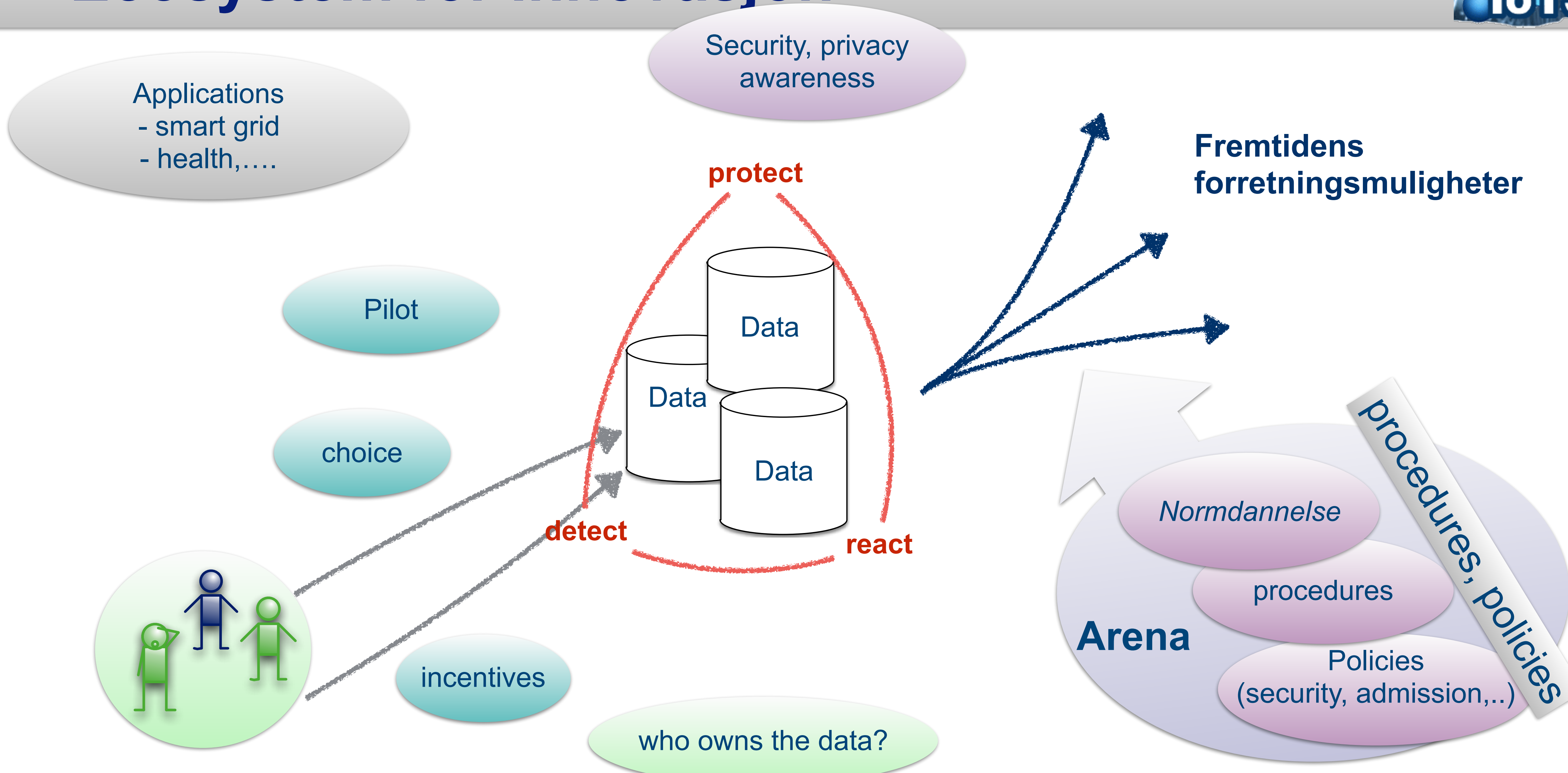


- Smart Meter
  - ➔ read and control
  - ➔ logic?
- Smart Home
  - ➔ intelligent devices
  - ➔ on-demand regulation
- Challenges
  - ➔ Logic: Centralised  $\longleftrightarrow$  Fog
  - ➔ Smart Meter: Information  $\longleftrightarrow$  Control
  - ➔ Smart Grid Information  $\longleftrightarrow$  Internet Info



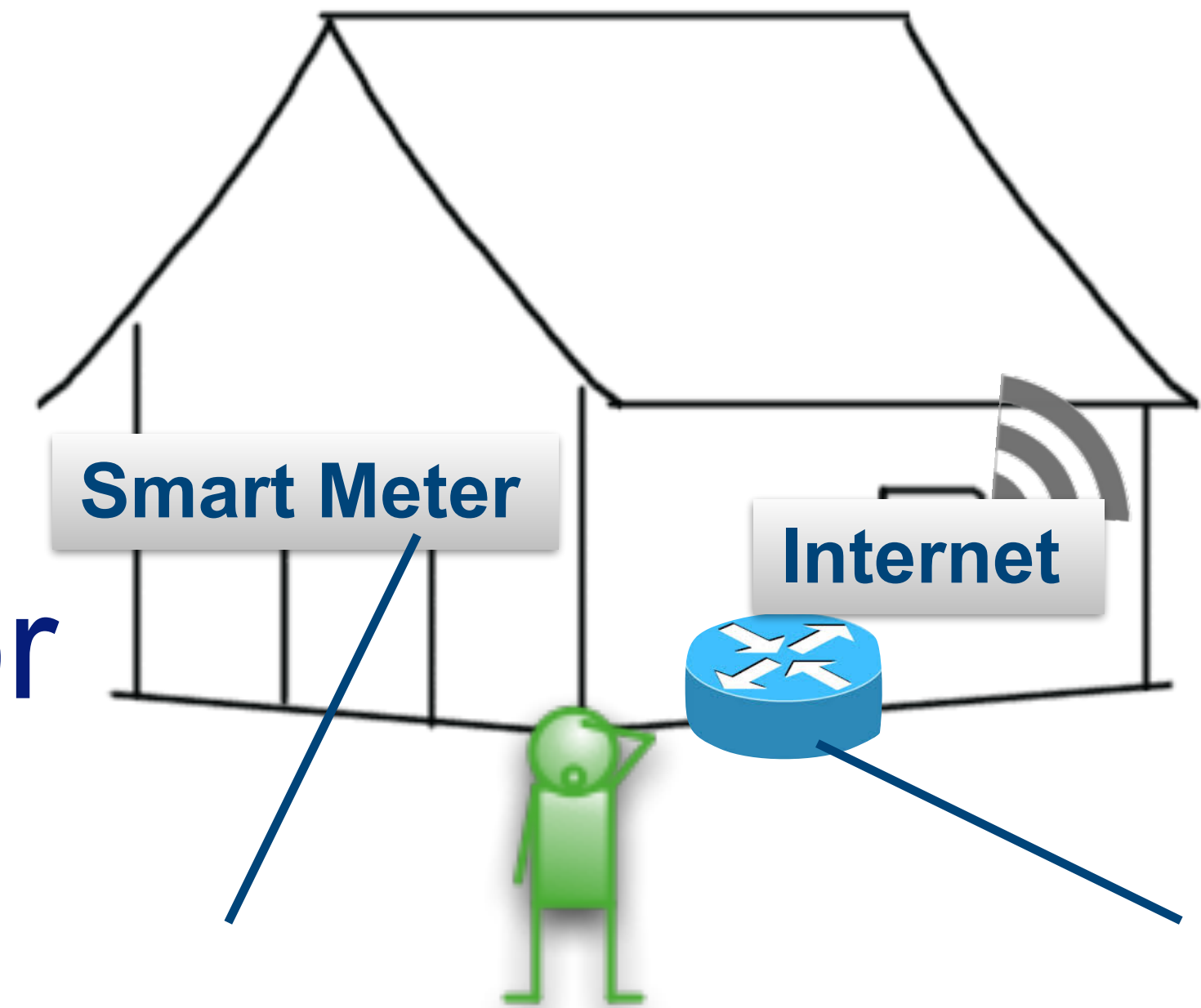
[source: [seminaronly.com](http://seminaronly.com)]

# Future Services in SmartGrid Ecosystem for Innovasjon



## IoTSec.no

Roadmap: “Research on IoT security”  
“Building the national Security Centre for Smart Grid”



<http://IoTSec.no>



# Knowledge and collaboration space

## <http://IoTSec.no> - #IoTSec, #IoTSecNO



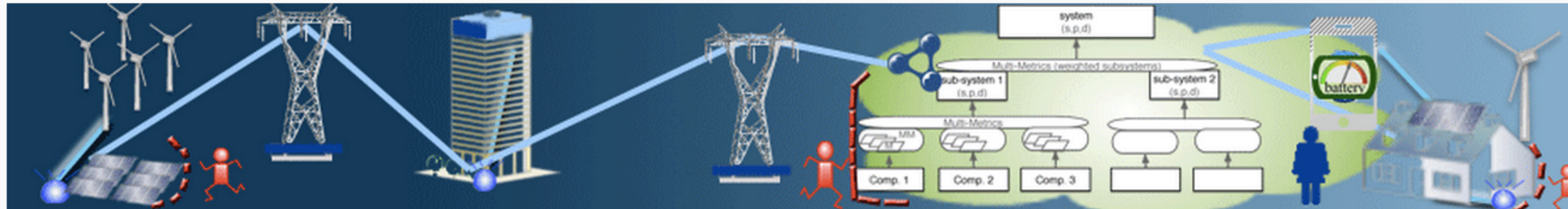
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Security Centre

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About us



The IoTSec - Security in IoT for Smart Grids initiative was established in 2015 to promote the development of a safe and secure Internet-of-Things (IoT)-enabled smart power grid infrastructure. The [Research Project](#) received funding from the [Research Council of Norway \(RCN\)](#) to contribute to a safe information society.

IoTSec addresses the basic needs for a reliable and efficient, uninterrupted power network with dynamic configuration and security properties. It addresses in addition the needs of businesses and end users of additional IoT services by exploring use cases for value-added services with the intent to design the building blocks for future services that consider the necessary security and privacy preconditions of successfully deployed large-scale services. IoTSec will apply the research in the envisaged Security Centre for Smart Grids, co-located with the Norwegian Centre of Excellence (NCE Smart).

### About

The IoTSec initiatives drives Research for secure IoT and Smart Grids

#iotsecno



Josef Noll  
@josefnoll

11 Nov

NCE Smart Partnerkonferansen med @KristinHalvorsen og Nasjonalt senter for Sikkerhet



«Open World Approach»  
*everything that is not declared closed is open*



# The threat dimension

- Hollande (FR), Merkel (DE) had their mobile being
- «and we believe it is not happening in Norway?»

18. Dezember 2014, 18:14 Uhr Auhören von Handys

## So lässt sich das UMTS-Netz knacken



[source: [www.rediff.com](http://www.rediff.com)]

[source: Süddeutsche Zeitung, 18Dec2014]

Zwei Hacker zeigen UMTS-Antenne lassen sich knacken. (Foto dpa)